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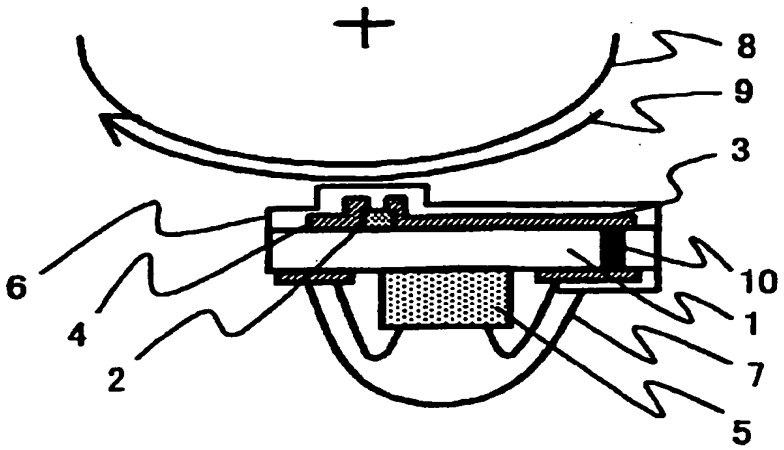
(54) Thermal head

(57) By a head constitution which does not influence the miniaturization of the thermal head and the platen diameter, a completely straight path is materialized to lower the cost. Using through hole connection (10) or turnup terminal connection (11), a driving element (5), a connecting portion, and encapsulation (7) for the protection thereof are provided on a surface opposite to a surface where a heater resistor (2) is formed.

FIG. 1



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Description

[0001] The present invention relates to a thermal head for use in thermal recording in a facsimile machine, a printer, or the like.

[0002] In a conventional thermal head, as shown in Fig. 5, an individual electrode 3 connected to one end of a heater resistor 2 is connected to a driving element 5. The other end of the heater resistor 2 is connected to a common electrode 4. All of them are provided on the same plane on an insulating substrate 1.

[0003] The individual electrode 3 and the driving element 5 are connected by wire bonding or flip chip. The driving element 5 and the connecting portion are, for protection, encapsulated on the periphery of the driving element using epoxy resin or the like. The encapsulation covers the whole of the driving element 5 and the connecting portion, and further, for the purpose of securing the reliability, has the width and the height which are larger than those of the driving element 5 and the connecting portion. This follows that, in order to avoid interference with a platen for advancing paper by rotating together with the paper, the position of the encapsulation is required to be apart from the heater resistor 2 by a predetermined distance. However, on the other hand, in order to lower the cost of the thermal head, it is necessary to make the width of the substrate as small as possible to increase the number of the thermal heads taken from one process unit substrate. Therefore, by, for example, making the platen diameter as small as possible to avoid the interference and to realize both decrease in the width of the substrate and the avoidance of the interference between the encapsulation and the paper 9 and the platen 8. However, to make small the platen diameter has problems such as insufficient strength and deflection of the platen and decrease in the amount of collapse (contact area with the paper) by pressing pressure, and thus, adversely affects the printing quality. Therefore, about 5 mm to 10 mm is thought to be the lower limit of the platen diameter, which means that, in order to avoid the interference with the encapsulation, it is not possible to make the width of the substrate smaller beyond a certain extent.

[0004] Since, in this constitution, paper is inserted so as to keep out of the encapsulated portion, the paper insert path is curved, and thus, hard cardboard, plastic paper which is difficult to fold, and the like can not be used for printing. Therefore, conventionally, with regard to these kinds of paper difficult to fold, in order to secure a straight path (a straight paper insert path), an end face type thermal head as shown in Fig. 6 where the heater resistor 2 is provided on an end face of the substrate and the driving element 5 is provided perpendicularly to the heater resistor 2 and a near edge type thermal head as shown in Fig. 7 where the interference with the encapsulated portion is avoided by providing the heater resistor 2 at an edge portion of the substrate and slanting the thermal head are used. Further, recently, a method has been thought of where, as shown in Fig. 8, a concave portion is processed in a part of the insulating substrate 1 such that a step is provided in the substrate itself for making a portion where the driving element 5 is provided lower than the heater resistor 2.

[0005] However, with regard to all of the above-described methods, since the shape of the substrate is complicated, its processing is difficult, and, since its patterning has to be carried out with regard to different surfaces or a surface having a great step, the manufacturing method is complicated and it is difficult to lower the cost.

[0006] In order to solve these problems, according to the present invention, by carrying out electric connection between front and rear surfaces of a substrate using through hole connection or turnup terminal connection, a driving element can be provided on the rear surface of a heater resistor.

[0007] By the present invention, there is no encapsulation on the side where the heater is provided, a straight path which is completely flat can be materialized, and there is no interference between a platen and paper and encapsulation. Therefore, the substrate size can be made smaller. Further, though, conventionally, the platen diameter has to be made smaller to make the thermal head size smaller, a necessary platen diameter can be selected independently of the width of the substrate. Still further, by providing the driving element on the rear surface, area for the provision of the driving element which is conventionally necessary becomes unnecessary, and the width of the substrate can be made further smaller.

[0008] Embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:-

Fig. 1 is a cross-sectional view of a thermal head in case through hole connection is used according to the present invention;

Fig. 2 is a cross-sectional view of a thermal head in case turnup terminal connection is used according to the present invention;

Fig. 3 is a plan view of the thermal head in case the through hole connection is used according to the present invention;

Fig. 4 is a plan view of the thermal head in case the turnup terminal connection is used according to the present invention;

Fig. 5 is a cross-sectional view showing a conventional thermal head;

Fig. 6 is across-sectional view showing another conventional thermal head;

Fig. 7 is a cross-sectional view showing still another conventional thermal head; and

Fig. 8 is a cross-sectional view showing yet still another conventional thermal head.

(Embodiment 1)

[0009] An embodiment of the present invention is described in the following in detail based on the drawings.

[0010] Fig. 1 is a cross-sectional view of an embodiment using through hole connection. As shown in Fig. 3A, the thermal head is of a U-turn electrode constitution where two heater resistors form one dot.

[0011] In Fig. 1, pairs of two heater resistors 2 with each pair forming one dot are arranged in a line on the front surface side of an insulating substrate 1. One heater resistor of each pair is electrically connected to an individual electrode 3 and the other heater resistor is electrically connected to a common electrode 4 with a U-turn electrode sandwiched between the heater resistors. The periphery is protected by a protective film. The end of each of the individual electrodes which is opposite to the end connected to a heater resistor is connected to a through hole. Electric connection to the rear surface side of the insulating substrate 1 is carried out through the through hole 10. On the rear surface side, the individual electrode is further extended through each of the through holes. Each of the individual electrodes is connected to a driving element 5 by wire bonding, flip chip, or the like. The driving element and the connecting portion are covered with encapsulation 7 formed of a resin of an epoxy system or the like.

[0012] On the other hand, with regard to the side of the common electrodes, all the common electrodes are connected together in a strip-like pattern on one side of the insulating substrate 1. Electric connection to the rear surface side of the insulating substrate 1 is carried out through a plurality of through holes in the pattern. By electric current passing from the common electrodes to the individual electrodes selected by the driving element, a part of the heater resistors generate heat.

[0013] Here, preferably, the diameter of the through holes is 0.05 mm or smaller and the intervals between the through holes are 0.1 mm or smaller. This is because the dot pitch in case the dot density of the heater resistors is 200 DPI (8 dots/mm) is 0.125 mm. However, in actual formation of the through holes, if it is difficult to process such through holes having a small diameter at such a small pitch, it does not matter even if the diameter is 0.05 mm or larger and the intervals between the through holes are 0.1 mm or larger. In that case, it is necessary to effectively arrange the through holes so as to be staggered according to their size. This is also true of the case of 200 DPI or more.

[0014] In order to carry out electric connection between the front and rear surfaces of the insulating substrate through the through holes, a method where the inside of the through holes is filled with a conductor, a method using wet plating, a method using vacuum film formation, or the like is used. It is necessary that the current capacitance of 5 - 100 mA or more can be secured per through hole.

[0015] The above description is with regard to the case of the thermal head having the U-turn electrode constitution. However, the same can be said with regard to a thermal head having a common electrode constitution where one dot is formed of one heater resistor as shown in Fig. 3B.

(Embodiment 2)

[0016] Fig. 2 is a cross-sectional view of an embodiment,using turnup terminal connection. As shown in Fig. 4A, the thermal head is of a common electrode constitution where one heater resistor forms one dot.

[0017] In Fig. 2, heater resistors 2 each forming one dot are arranged in a line on the front surface side of an insulating substrate 1. One end of each heater resistor is electrically connected to an individual electrode 3 and the other end is electrically connected to a common electrode 4. The periphery is protected by a protective film. One end of each of the individual electrodes is connected to a heater resistor. The other end extends to the vicinity of an end face of the insulating substrate, and is electrically connected to the rear surface side of the insulating substrate 1 using a turnup connection terminal 11. On the rear surface side, the respective turnup connection terminals are connected so as to make one-to-one correspondence to individual electrodes on the rear surface side. Each of the individual electrodes is connected to a driving element 5 by wire bonding, flip chip, or the like. The driving element and the connecting portion are covered with encapsulation 7 formed of a resin of an epoxy system or the like.

[0018] On the other hand, with regard to the side of the common electrodes, all the common electrodes are connected together in a strip-like pattern on one side of the insulating substrate 1. Electric connection to the rear surface side of the insulating substrate 1 is carried out through the turnup connection terminals in the pattern. By electric current passing from the common electrodes to the individual electrodes selected by the driving element, a part of the heater resistors generate heat.

[0019] Here, preferably, the terminal pitch of the turnup connection terminals is 0.1 mm or smaller and the space between terminal widths is sufficient. This is because the dot pitch in case the density of the heater resistors is 200 DPI (8 dots/mm) is 0.125 mm, and for the purpose of avoiding short circuit between adjacent dots due to misalignment when the terminals are connected or misalignment in patterning between the front and rear surfaces. In case of 200 DPI or more, turnup connection terminals having a narrower pitch according to the size are necessary.

[0020] In order to carry out electric connection b tween the front and rear surfaces of the insulating substrate through the turnup connection terminals, a method where a flexible pattern circuit (FPC) is used and the connection is carried out by soldering or an ani-

sotropic conductive film, a method where clip-like metal terminals are aligned, a method where the connection is carried out by wire bonding, or the like is used. It is necessary that the current capacitance of 5 - 100 mA or more can be secured per terminal.

[0021] The above description is with regard to the case of the thermal head having the common electrode constitution where the strip-like common electrode is provided in the vicinity of the heaters. However, the same can be said with regard to a thermal head of a type where common electrodes are wired on both sides of an insulating substrate as shown in Fig. 4B.

[0022] By a thermal head according to the present invention, there is no encapsulation on the side where the heaters are provided, and a straight path which is completely flat can be materialized. By providing the driving elements on the rear surface, area for the provision of the driving elements which is conventionally necessary becomes unnecessary on the side where the heater resistors are provided, and the width of the substrate can be made further smaller. Still further, though conventionally, for the purpose of making the thermal head size smaller, the platen diameter has to be made smaller at the expense of the printing quality, in this invention a necessary platen diameter can be selected independently of the width of the substrate, and the degree of freedom in designing the thermal printer is remarkably improved.

[0023] Also, the shape in going through the manufacturing process is simplified, the number of the thermal heads taken from one process unit substrate is increased, and the productivity is improved, which greatly contributes to lowering of the cost.

Claims

1. A thermal head comprising heater resistors arranged in a line on an insulating substrate, individual electrodes electrically connected to said heater resistors, respectively, common electrodes disposed so as to be electrically connected to said individual electrodes through said heater resistors, a protective film for protecting said heater resistors, said individual electrodes, and said common electrodes, and driving elements connected to said individual electrodes, respectively, part of said heater resistors generating heat by electric current from said common electrodes passing through said individual electrodes selected by said driving elements, wherein: said individual electrodes electrically connected to said heater resistors and said common electrode are electrically connected between front and rear surfaces of said insulating substrate, and said driving elements are provided on the opposite surface to the surface where said heater resistors are provided.

2. A thermal head as claimed in claim 1, wherein said electric connection between said front and rear surfaces is carried out through through holes penetrating in the thickness direction of said insulating substrate.

3. A thermal head as claimed in claim 1, wherein said electric connection between said front and rear surfaces is carried out through turnup connection terminals on an end face of said insulating substrate.

FIG. 1

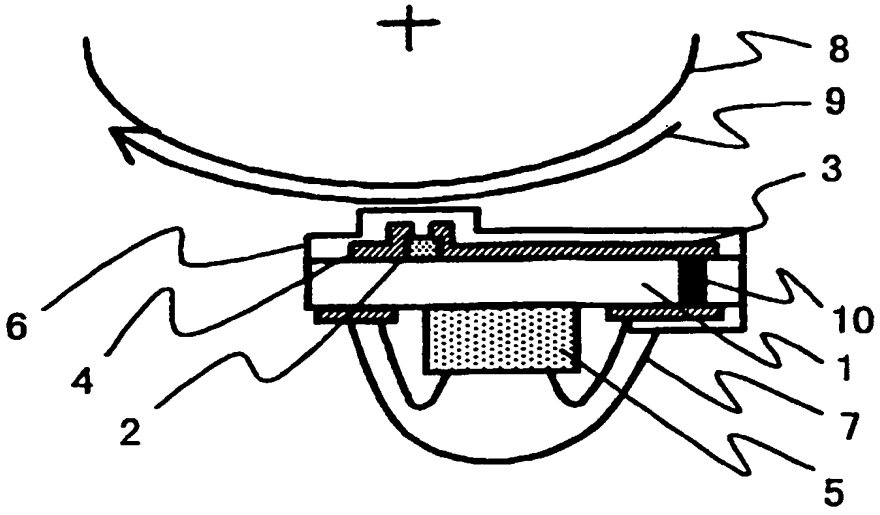


FIG. 2

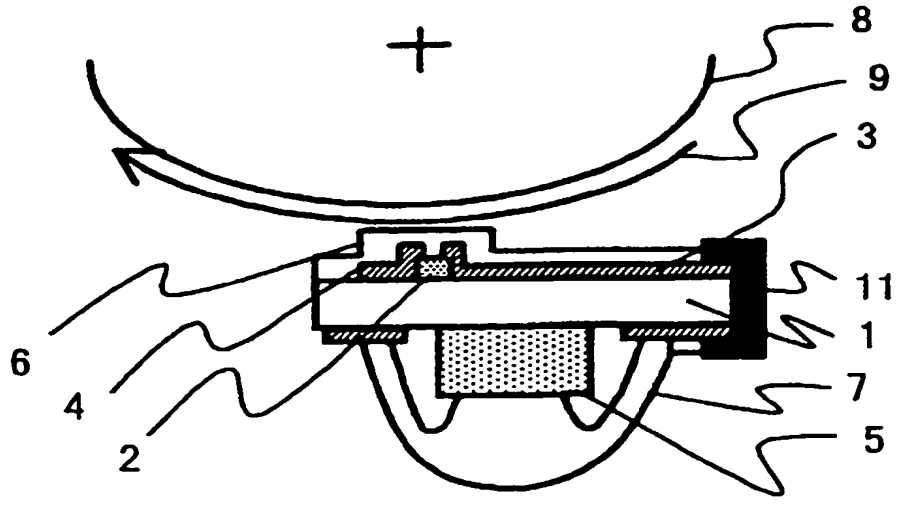


FIG. 3A

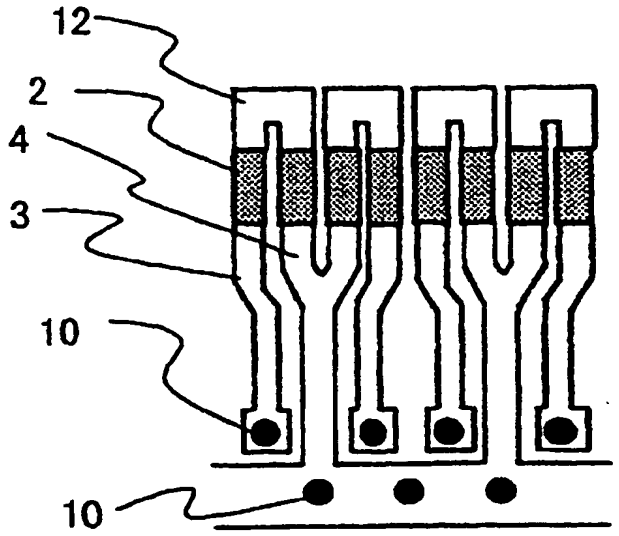


FIG. 3B

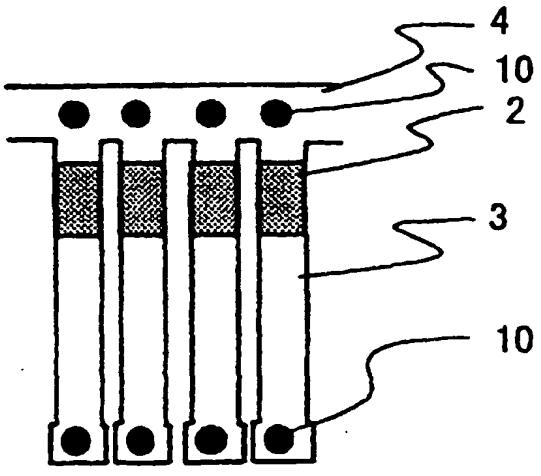


FIG. 4A

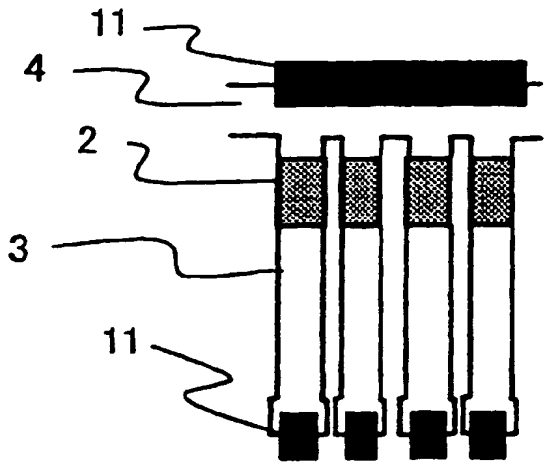


FIG. 4B

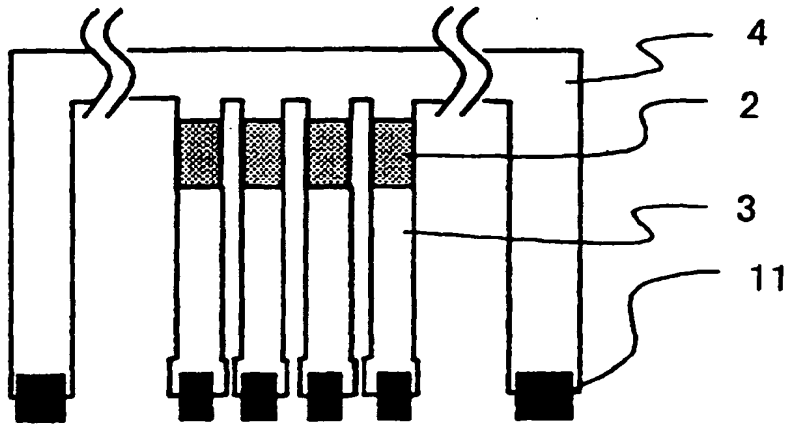


FIG. 5

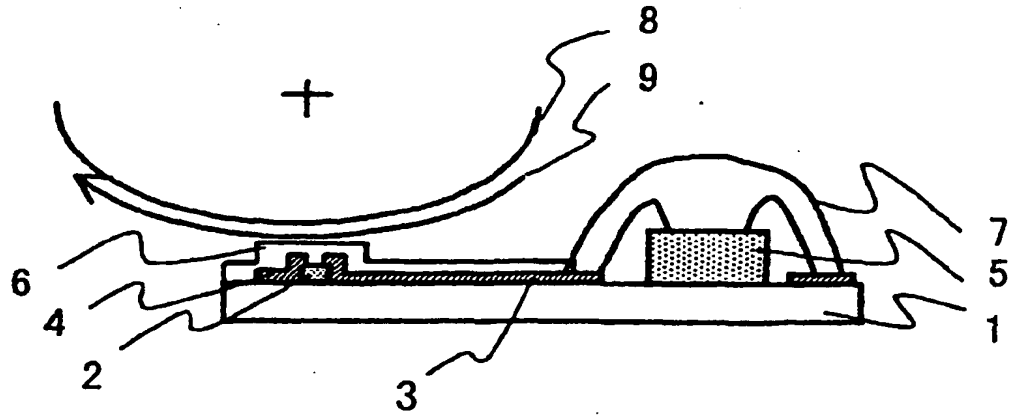


FIG. 6

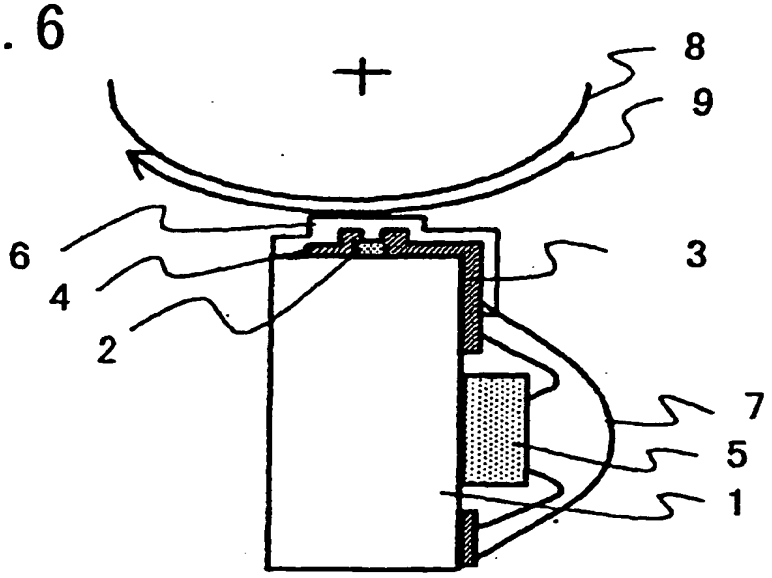


FIG. 7

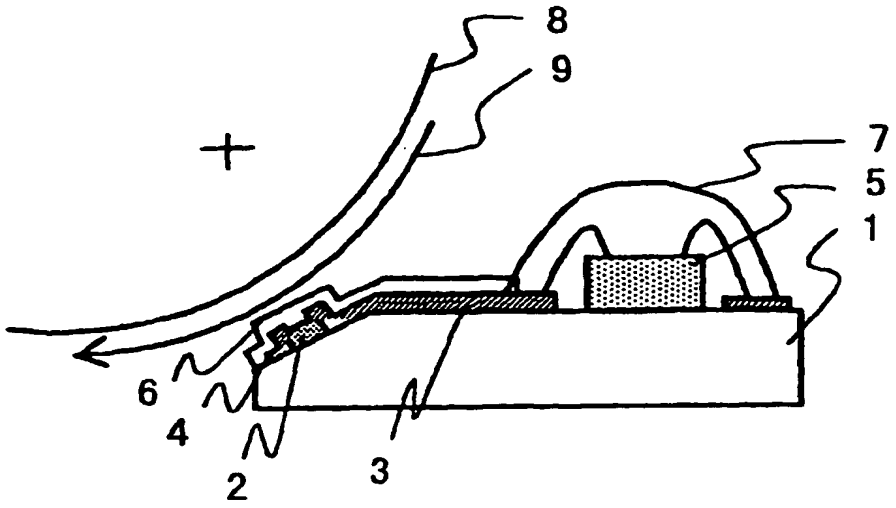
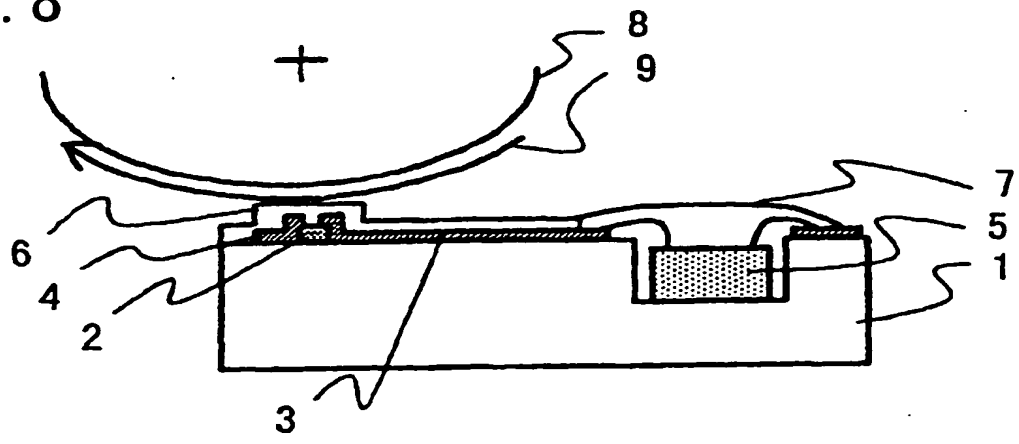


FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 00 30 6384

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 016, no. 414 (M-1303), 2 September 1992 (1992-09-02) & JP 04 140153 A (ALPS ELECTRIC CO LTD), 14 May 1992 (1992-05-14) * abstract *	1-3	B41J2/335
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	3 November 2000	Bridge, S

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